FIELD GUIDEBOOK

to

ENVIRONMENTS OF COAL FORMATION

IN

SOUTHERN FLORIDA

Trip Leaders

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PRE-CONVENTION FIELDTRIP

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destroyed the mangrove forest that deposited this peat and brought about the deposition of the shelly surface sediment that overlies most of the bay. Influx of marine water into the bay is also reflected by a sharp increase in the relative abundance of aragonite over calcite in bay sediments; the aragonite is chiefly derived from mollusk shells (Figure 26 and Taft and Harbaugh, 1964).

STOP 14: Oyster Bay Site

Objectives:

A. Inspection of sediments in the open water area near the entrance to Whitewater Bay.

B. Discussion of the sedimentary facies in Florida Bay, Whitewater Bay and Oyster Bay.

C. Discussion of the relationship between the marine transgression and post-glacial sea level rise.

Discussion:

Broadening of Whitewater Bay to its present size has apparently been under way since about 3000 B.P. Because southern Florida is thought to have remained tectonically stable during this time, the sedimentary section in Whitewater Bay must record the final phases of the world-wide post-glacial rise in sea level (Scholl, in press, A). A curve showing this rise in sea level across southern Florida is given in Figure 30.

The next stop, Stop 14, will be west of Cormorant Pass in Oyster Bay (Figure 27). This area is near the entrance to Whitewater Bay and therefore is swept by tidally generated currents. As a consequence, the floor is covered with only a thin veneer of relatively coarse shelly sediment. The molluscan fauna is also essentially marine in character.

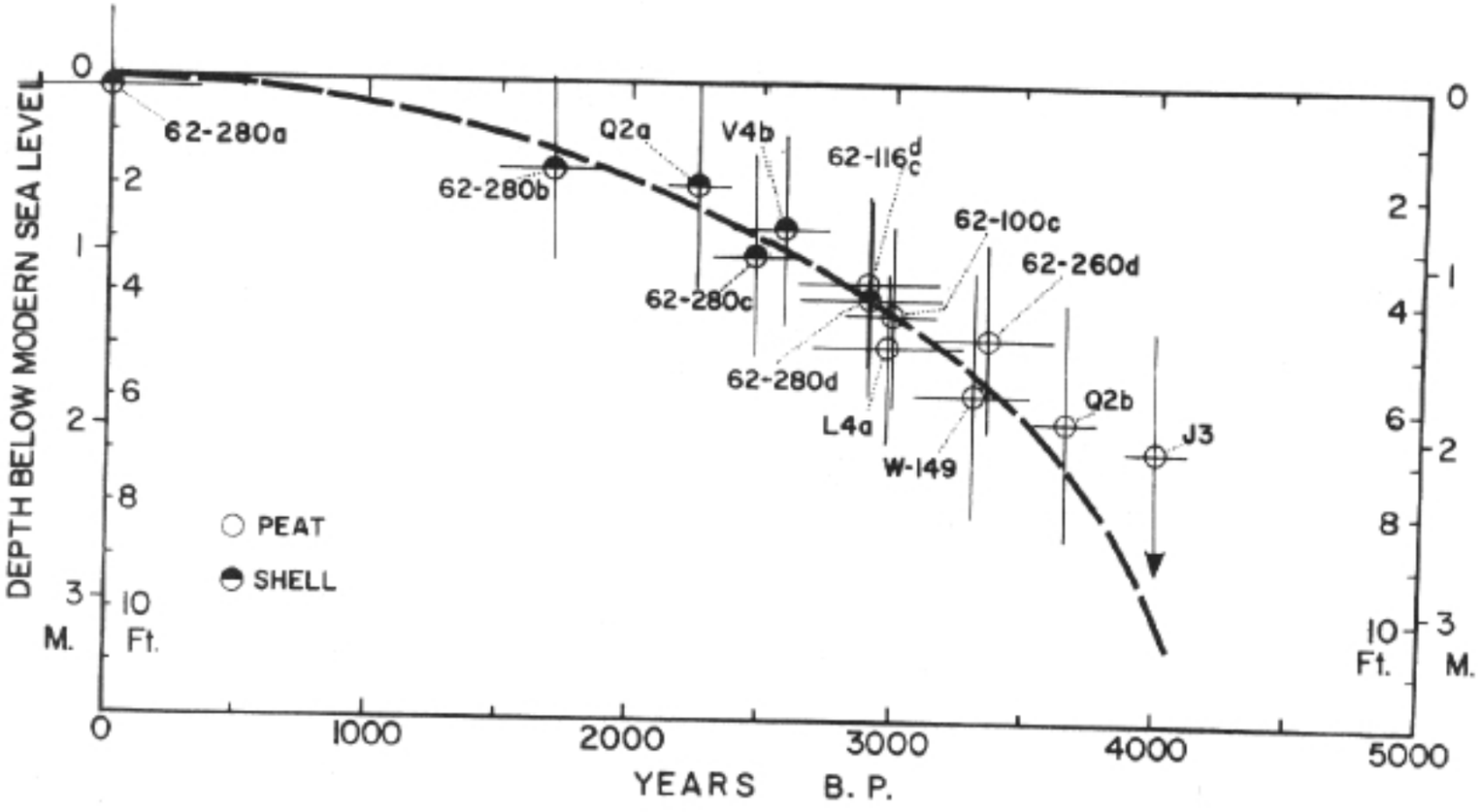
STOP 16: Cape Sable Buried Forest

Objectives:

A. Inspection of the effects of shoreline processes interacting with swamp environment processes - Sector 1: an "exposed" coastline.

B. Inspection of a black mangrove swamp.

C. Discussion of Cape Sable shoreline development.



CURVE SHOWING RATE OF SEA LEVEL RISE DURING LAST 4000 YEARS

Figure 30

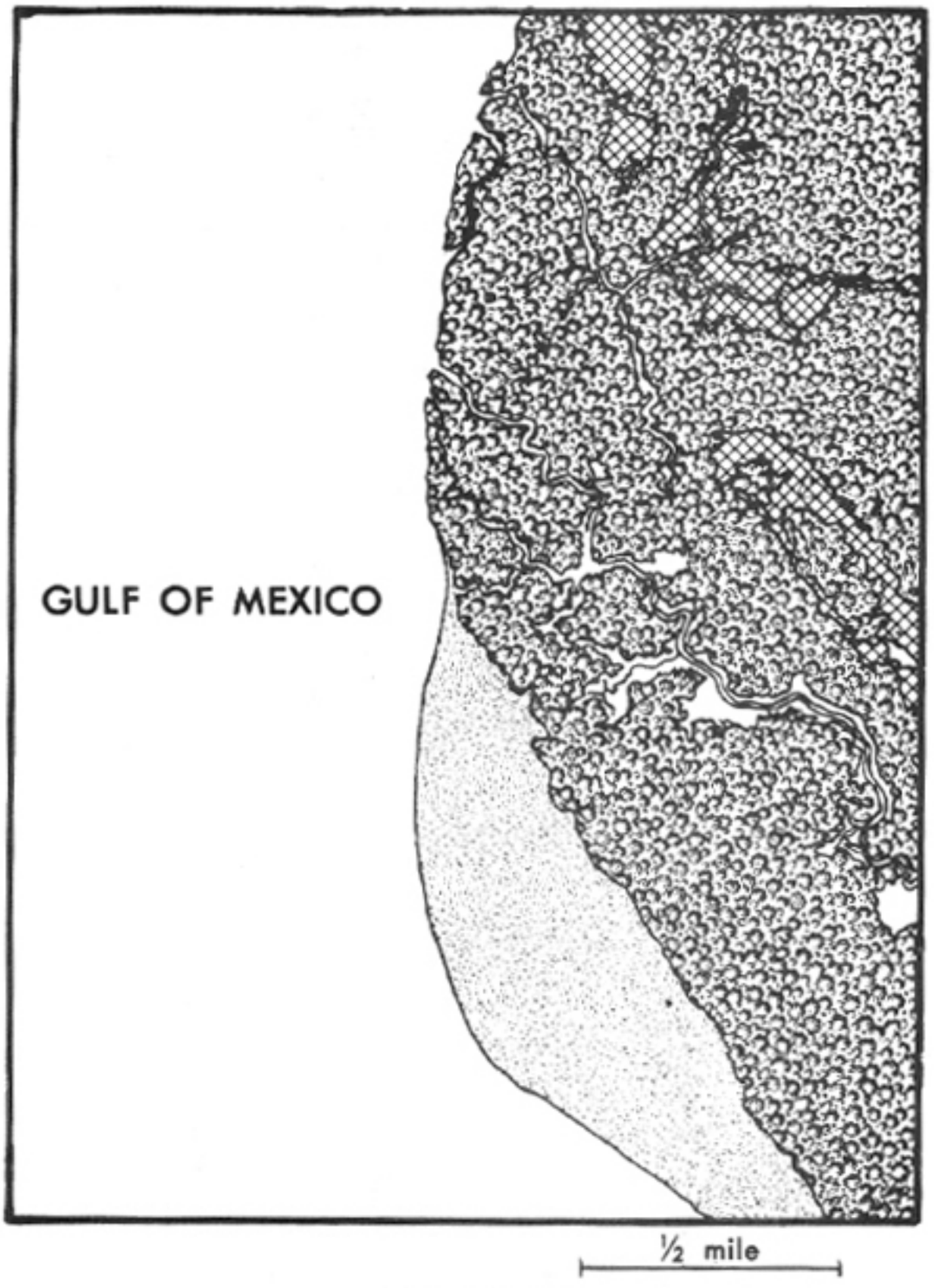
Curve showing rise in sea level across southwestern Florida. Vertical line through data points indicates range of uncertainty in positioning former stands of sea level; horizontal line gives age uncertainty. Arrow at base of vertical line means sea level was probably below plotted data control point.

D. Discussion of forest peat buried beneath storm beach.

Discussion:

The three major environments in the vicinity of "Northwest Cape" are the beach environment, the black mangrove environment and the marl prairie (Figure 31). One of the most interesting features of this site is the buried forest shown in Plate XI. As is evident from the photograph in the Plate, the black mangrove forest recently extended further to the west. It was developed on a layer of peat that is visible at the water's edge with black mangrove stumps still standing on the peat surface. Dead mangrove stumps are also visible projecting up through the beach ridge that was produced after or during the destruction of the living margin of the forest. Behind the beach ridge is the beginning of an extensive forest swamp that occupies many square miles to the north and east.

Before discussing the features of the site in detail, some comments on the shoreline development of Cape Sable may be of interest. Plate XII shows the prominence of land that is called Middle Cape. The successively developed beach ridges are reasonably well-defined in this photograph. Similar photographs could be presented for the other two prominences, namely East Cape and Northwest Cape. The locations of these three capes relative to one another and to Stop 16 are shown in Figure 32 and Plate XIII. Initial inspection of the photo mosaic might suggest that these "capes" are the products of the present coastline developmental processes. This may be the case, however, attention is called to the truncation of the ridges on the west in the case of Northwest and Middle Capes and on the east in the case of East Cape. Moreover, erosion of the coastline north of Northwest Cape is evident not only from the truncated beach ridges but also from the course of the small stream that meanders out into the Gulf of Mexico and then back into the land mass (see Plate XIII and Figure 31). It is difficult to say whether the present net effect along this coastal sector is one of deposition or erosion. In terms of the last 3000 - 4000 years, the situation is much clearer. The net effect over this period of time has been one of aggradation. Several successively older coastlines are evident in the mosaic (Plate XIII). Five of these have been represented and labelled in the map presented

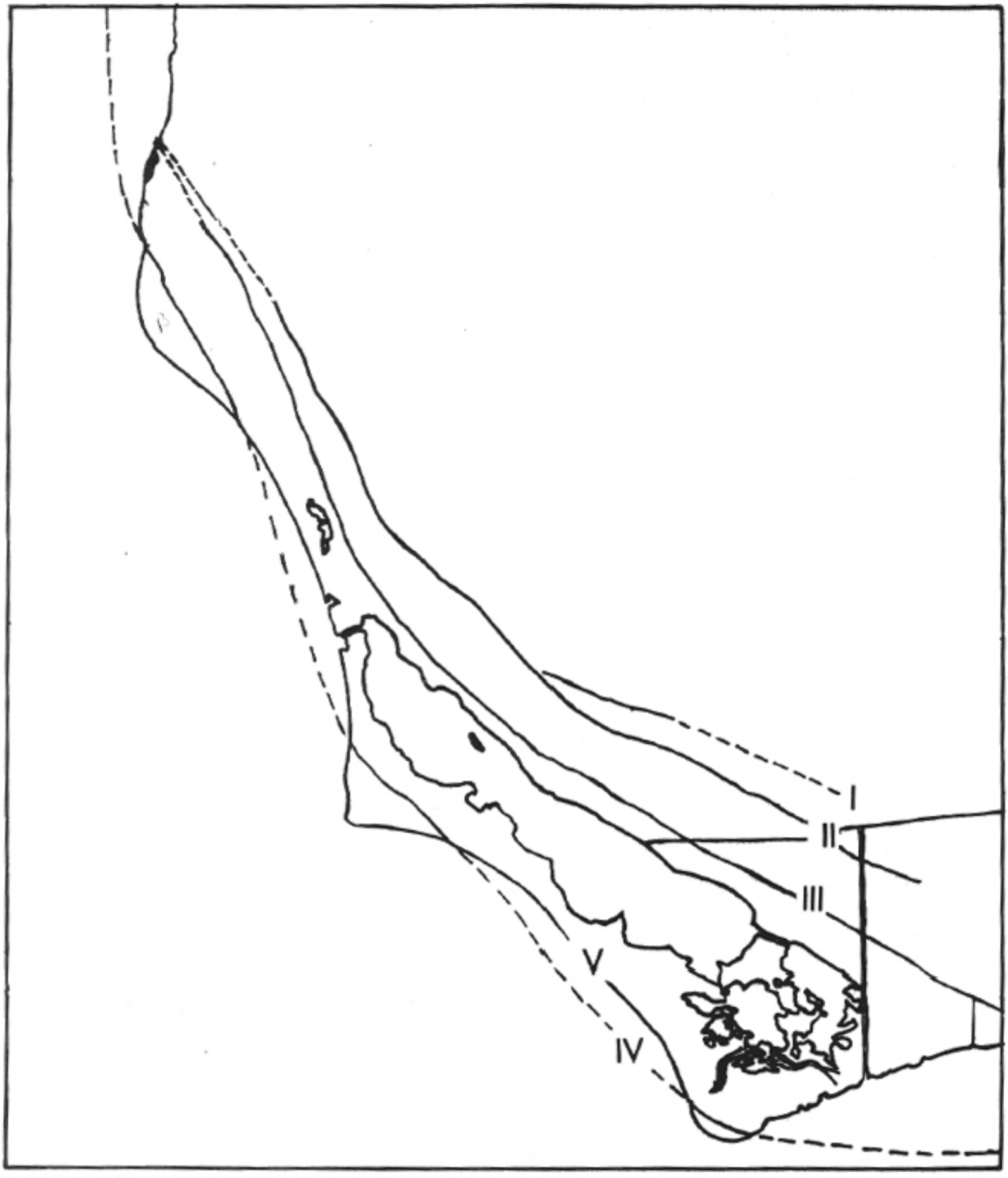


MAP OF ENVIRONMENTS IN THE NORTHWEST CAPE AREA

Figure 31

PLATE XI

PLATE XII



CAPE SABLE SHORELINES

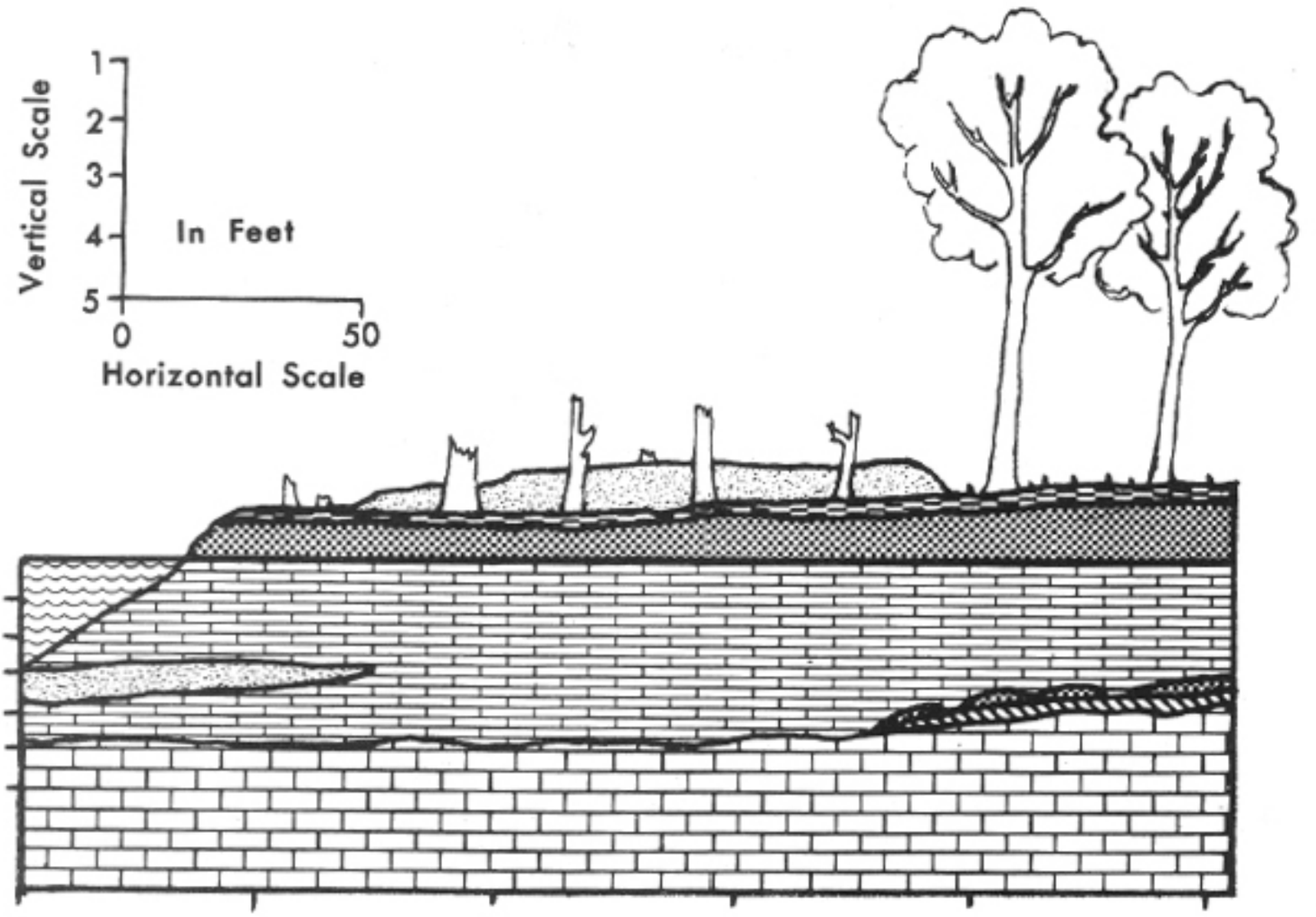
Figure 32

PLATE XIII

as Figure 32. The more accomplished eye will probably detect even more, or suggest modifications of the interpretation presented in this Figure. However, the fact will remain that this coastline has been moving in a southwestward direction as the result of the accumulation of marine marl over the past few thousand years.

At the site of the buried forest the marine marl referred to above will be found immediately beneath the peat stratum that presents its eroded margin at the low-tide shoreline (Figure 33). The composition and origin of this marl has been discussed and need not be reviewed here. The peat will be recognized as red mangrove peat in spite of the fact that the stumps are obviously those of Avicennia and not Rhizophora. This is not surprising in view of the red mangrove's ability to colonize shallow open water areas along the coast. The presence of the peat on the marl documents the existence of a period of time during which swamp-forming processes overcame the tendency for beach-forming processes to dominate in this coastal sector. The swamp forest was built out to well beyond the present peat margin and peat deposited under a red mangrove swamp environment. The black mangrove which dominates at this site cannot colonize in open marine waters (Davis, 1940) and typically inhabits the areas that lie behind the pioneer mangrove stand in which the high tide waters provide a more shallow cover. In normal swamp environments, black mangrove occurs at the coastline only as the result of a rapid transgression of the shoreline that destroys the marginal red mangrove zone, or as the result of the elevation of the soil surface through the rapid accumulation of either peat or inorganic detritus. In the case of the latter event, the coastline accumulation of sediment must essentially cease at the shoreline and the entry of the surface into open water must be steep or a red mangrove zone will be retained.

It will be noted that the upper surface of the peat stratum contains large quantities of calcareous material, foretelling the event that is so dramatically shown by the beach that sits upon the peat layer. Inspection of the beach will show that it is composed almost entirely of shells and shell fragments, as are all of the beaches in this sector of the coastline. Beyond the beach the limey peat may again be observed on the surface



LEGEND

CARBONACEOUS MARL

PEAT

BEDROCK

FRESH WATER MARL

WATER

BEACH

SECTIONAL PROFILE THROUGH BURIED FOREST

Figure 33

with the red mangrove peat beneath it. Now, however, these form the sub-strata for the roots of living trees, as opposed to providing support for remnants of the seaward extension of this swamp forest.

This type of oscillation between peat-forming and beach-forming processes is not restricted to this site. Similar relationships of "inorganic" and organic sediments can be observed at other exposed sites along the southwestern coast of Florida. Shark Point and Highland Beach are two additional examples. In the case of the latter, the storm beaches and normal beach sediments are less calcareous and more siliceous, reflecting an increase in the amount of quartz contained in the bedrock of he source area (i.e. the Tamiami formation vs. the Miami oolite).

From the preceding description of Stop 16 and from the inspection of the Florida Bay - Whitewater Bay areas, it is evident that the deposition of calcareous marl predominates along the southwestern margin of Cape Sable. Also, there is an interfingering and intercalation of peat into these "inorganic" sediments. As one proceeds northeastward, the marl is soon completely replaced by peat, the latter forming a major part of the walls of the Whitewater Bay basin. Beyond Whitewater Bay, as one proceeds northeastward toward the Tamiami Trail, the peat blanket thins gradually. Figure 34 shows a 42 mile NE-SW section that illustrates these relationships. The bedrock rise in the profile represents a place where the transect passed over a prong of the Hammock and Glades Physiographic Sector (see Figure 3). This Sector borders the Slough area on the West and is a region in which the bedrock immediately underlies the thin veneer of surface sediment. The "Big Cypress Swamp" occupies all but the lowermost segment of this physiographic division.

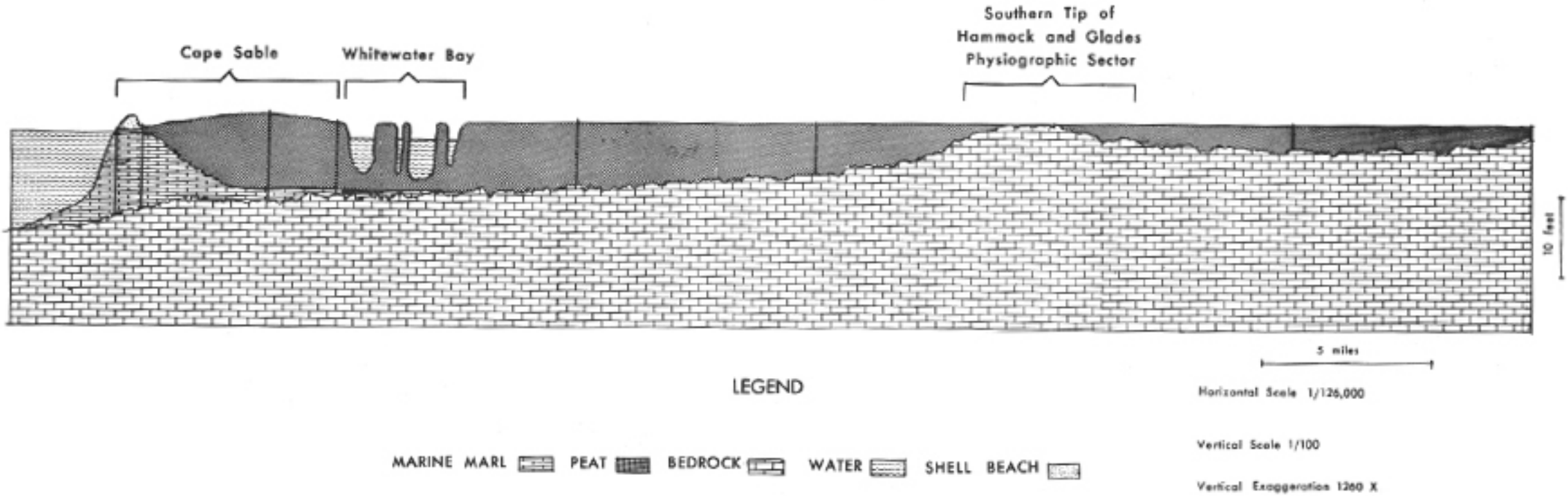
STOP 17: Big Sable Creek Site

Objectives:

A. Inspection of the effects of shoreline processes interacting with swamp environment processes - Sector 2: The Tidal Scour Sector.

B. Inspection of degraded mangrove peat.

C. Discussion of movement of organic material out of the swamp environment.



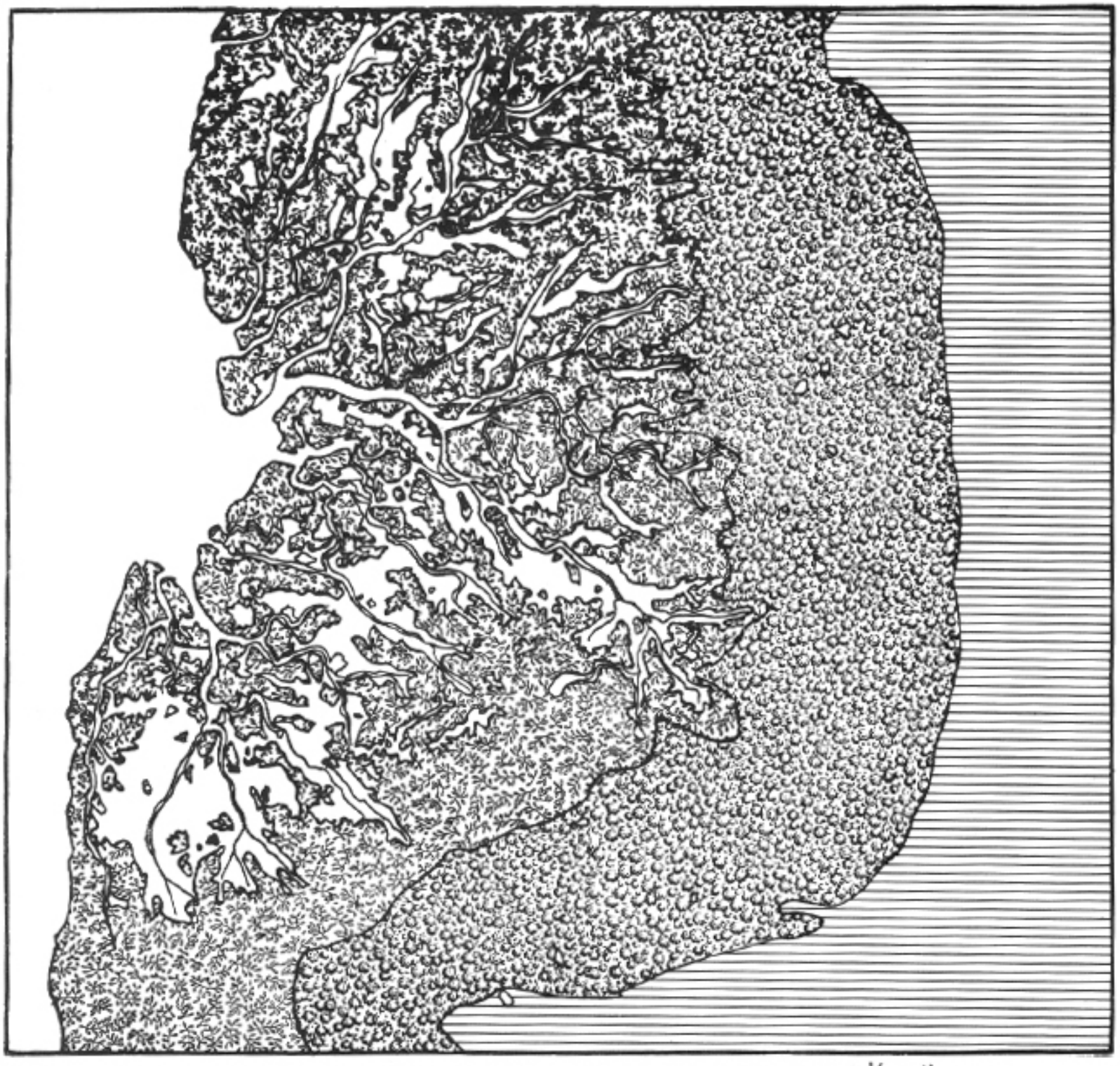
FORTY MILE SW-NE SECTION FROM CAPE SABLE TO VICINITY OF TAMIAMI TRAIL
Figure 34

D. Discussion of shorelines along the mangrove coast of southwestern Florida.

Discussion:

The area surrounding Big Sable Creek provides an excellent opportunity to observe the differences in ecological amplitude exhibited by the red and black mangroves. On the more exposed sites that are flooded twice daily to a depth of a foot or more, the red mangrove forms the major part of the plant cover. Behind the zone that is covered deeply by the tides, a mixture of black and red mangrove form the forest, with black mangrove dominating and red mangrove being most abundant along the slight depressions produced by minor channelization of tidal flow. Figure 35 shows the relationships of the areas occupied by these two swamp environments. The fact that these two environments are fairly well-defined in this particular locality should not be taken to mean that the mangrove boast is formed by a red mangrove belt along the shoreline with a belt of black mangrove behind it. Such is not the case, for the factors affecting the nature of the coastline vegetation are many and varied.

The aerial view of the Big Sable Creek Site (Plate XIV) shows an area in the tidal scour zone that is typical of the locality. The dead tree trunks lying like match-sticks on the bare peat flats have been killed and toppled by having their roots undermined. This undermining process has probably involved a removal of the upper peat layer by both chemical and physical action. The degraded peat seems to be produced by an initial, in situ, alteration (chemical?) that renders the mass more susceptible to disruption and transport. From the altered "peat mud" that covers the peat flats it is evident that the material moves seaward slowly, often making several stops before being destroyed or finding a resting place in open water. Plate XVA shows the organic debris as it flows out of the area. Longshore currents and wave action often cause some of the suspended organic debris to be deposited, at least temporarily, on the beach as shown in the picture of the Cape Sable shoreline south of Northwest Cape (Plate XVB). Much of the material that colors the streams flowing out of the swamps appears to be either in solution or

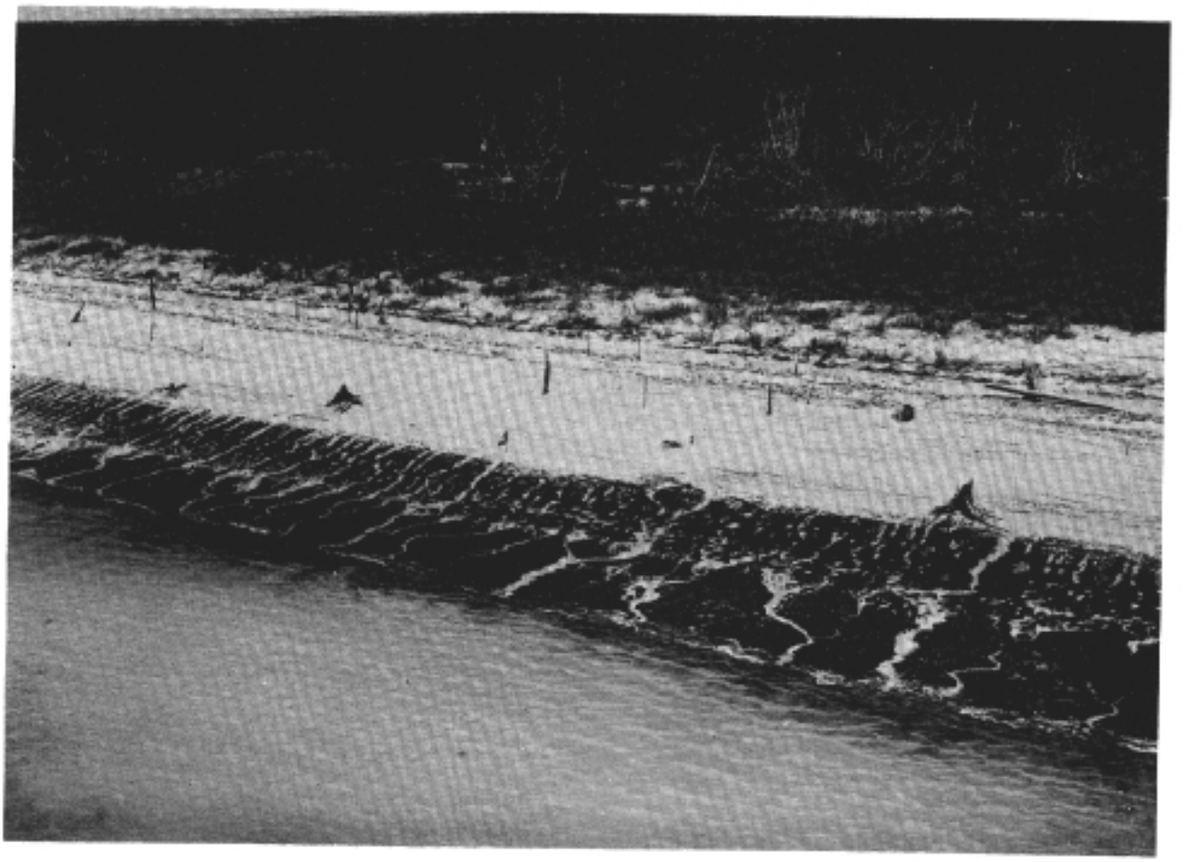


MAP OF ENVIRONMENTS IN THE BIG SABLE CREEK AREA

Figure 35

PLATE XIV

a



b

PLATE XV

in colloidal suspension, for attempts to extract the material by centrifuging have proved futile. The undermining processes together with the subsequent removal of the debris, have the effect of lowering the surface elevation, thus producing the bare peat flats and the areas tolerable only to the red mangrove.

This type of tidal flat characterizes the coastline from Little Sable Creek to the mouth of the Little Shark River. It is effectively illustrated in the copy of the Soil Conservation Service aerial photograph reproduced as Plate XVI. This Sector of the coastline contrasts markedly with the adjacent Sector to the south, where storm beaches are currently being formed and deposition of inorganic marl has dominated the coastline processes. To the north is an equal contrast where the "Slough Entry Sector" is composed of a series of islands with no "coastline" discernible. Further to the north the "River Sector" exhibits a smooth and well-defined coastline in spite of the large number of streams that enter the Gulf in that area. It differs from the Tidal Scour Sector in many ways, for in the Big Sable Creek area there are no streams of any consequence entering the Gulf. Above the River Sector lies the Bay Sector, characterized by the development of arcuate embayments along the coast and extensive lagoonal or bay areas that parallel the coast but lie two or three miles inland. Still farther north lies the spectacular Ten Thousand Island Sector, distinctly different in form and composition from all other Sectors. These segments of the coastline are identified on the map presented as Figure 36.

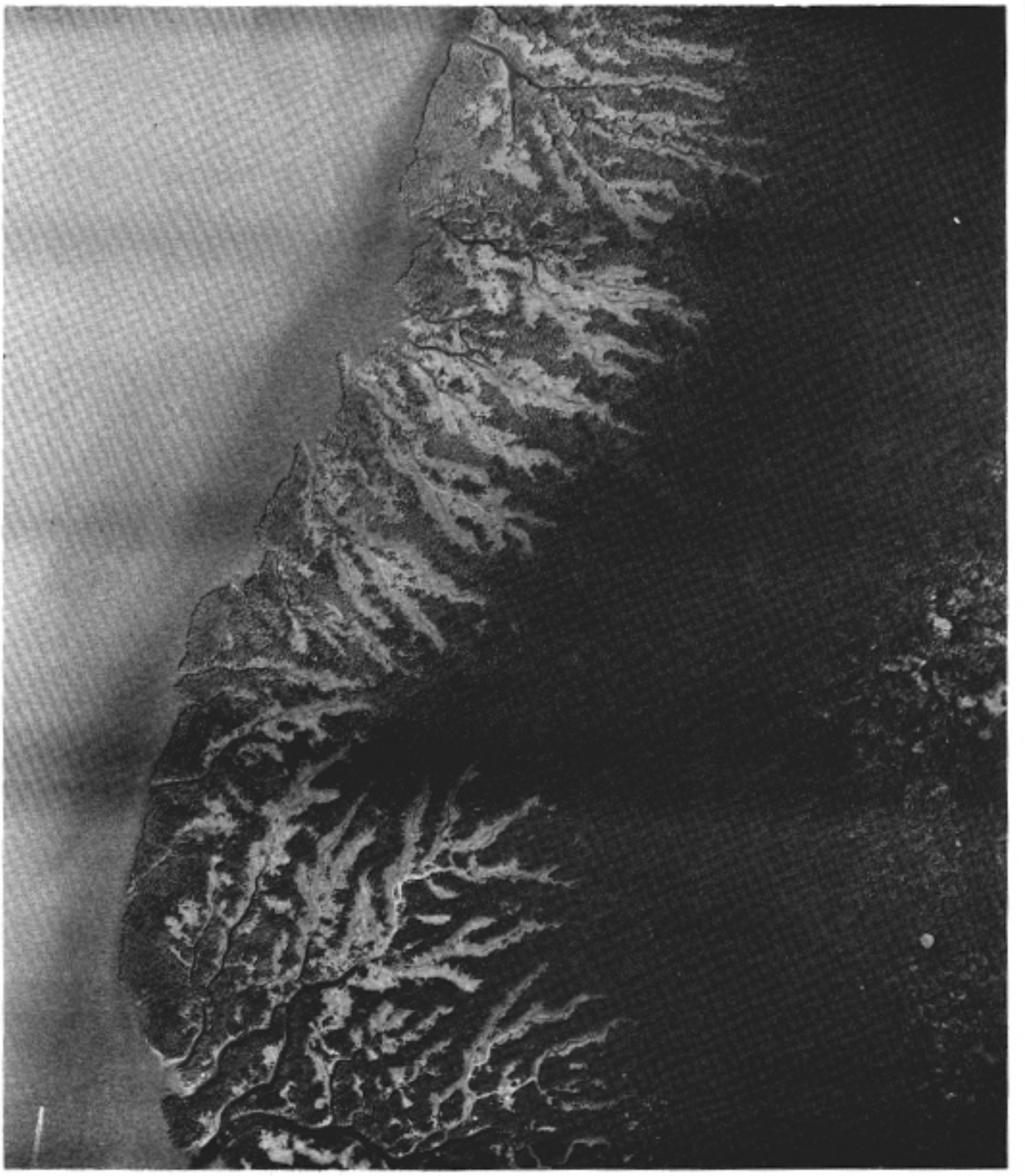
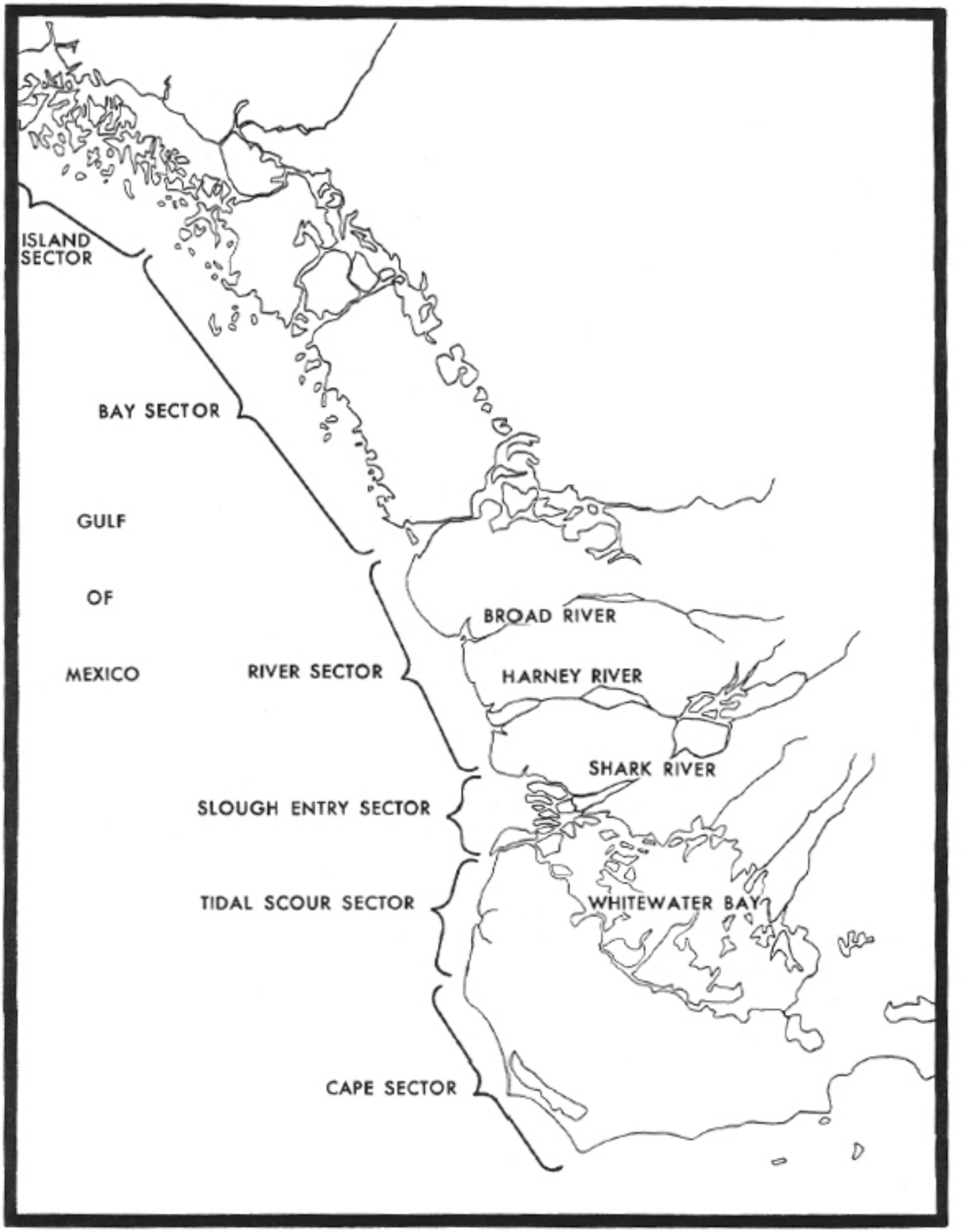


PLATE XVI



MAP OF SHORELINE TYPES COMPOSING THE MANGROVE COAST OF SOUTHWESTERN FLORIDA

Figure 36